

**Michigan Department of Environmental Quality – Air Quality Division’s
Atmospheric Mercury Monitoring Activities, July 2005
Monitoring in the Upper Peninsula, Lansing Area, and Detroit Area**

May 1, 2006

Introduction

In an effort to identify and quantify under-appreciated sources of mercury to the atmosphere, Michigan, Minnesota and Wisconsin jointly applied for and received funding from the U.S. Environmental Protection Agency (EPA). These funds were used to develop and apply quantitative tools to identify sources of mercury to the atmosphere. A summary of this grant activity can be found in the report entitled, “Identification of Atmospheric Mercury Sources in the Great Lakes States through an Ambient Monitoring Program (MDEQ 2003).”

Oak Ridge National Laboratory (ORNL) applied for and received a grant entitled, “Fugitive Mercury Emissions from Noncombustion Sources in the Great Lakes Region (FuME).” This grant sought to collaborate with the three states to facilitate further identification of fugitive mercury emissions. Mr. George Southworth of the ORNL joined Michigan Department of Environmental Quality (MDEQ), Air Quality Division (AQD) staff in July 2003 and July 2005 to conduct the monitoring activities as a part of this grant.



Picture 1. Tekran 2537A

Michigan designed and built a mobile mercury monitoring laboratory (M3L) complete with a propane-powered generator, two Tekran 2537A elemental mercury vapor analyzers (see Picture 1), meteorological monitoring equipment, data loggers, and a computer for data compilation and analysis as part of the EPA grant received by the three states. The M3L is housed in an air-conditioned trailer that has been shared among the three states for data collection (see Picture 4). On July 20-22, 2005, the M3L was used to monitor at Deer Lake in Michigan’s Upper Peninsula.

The EPA funding also allowed for the purchase and sharing of two Lumex RA915+ elemental mercury vapor analyzers (see Picture 2) for the identification of Hg(0) sources. The Lumex is one or two orders of magnitude less sensitive than the Tekran, but is much more portable and quicker to yield data. One of these Lumex RA915+ analyzers and a Lumex RA915+ owned by the ORNL were used to conduct monitoring in July 2005. Both the Tekran 2537A and the Lumex RA915+ are elemental mercury analyzers and thus the monitoring presented in this report only examined elemental mercury. The DEQ

also used their Lumex RA915+ to conduct monitoring around Continental Aluminum earlier in 2005 (see [Appendix B](#)).

The Lumex RA915+ was used in a series of car tour monitoring activities around the Detroit and Lansing areas and also for on foot monitoring around and in the facilities visited. During car tour monitoring, the monitoring probe was suspended in the ambient air through a partially open window. For the on-foot monitoring, the probe was held in the ambient air at approximately chest height. A handheld geocoordinate positions system (GPS) device (Garmin eTrex Vista) was also used to record locations where sampling occurred. Both car tour monitoring and monitoring on foot involved connecting the Lumex RA 915+ analyzer to a laptop that would automatically download the data collected from the continuous ambient monitor. Monitoring locations were chosen to provide representative samples of both upwind and downwind ambient mercury concentrations in the vicinity of the potential mercury sources monitored.



Picture 2. Lumex RA915+

Ms. Joy Taylor Morgan, Ms. Leah Granke, Ms. Amy Robinson (from the MDEQ AQD), and Mr. George Southworth (ORNL) conducted monitoring in the Detroit and Lansing areas on July 18 and 19, 2005. On July 20-22, 2005, monitoring was conducted in the Upper Peninsula by Ms. Taylor Morgan, Mr. Southworth, Ms. Granke, Mr. George Pelkola, and Mr. Doug Knauer (from the MDEQ Water Bureau).

Monitoring Summary

UPPER PENINSULA AREA MONITORING JULY 20-22, 2005

Deer Lake



Picture 3. Deer Lake

Deer Lake is a 906-acre impoundment located near Ishpeming, in Marquette County, Michigan. It is part of an Area of Concern (AOC) as defined by the U.S.-Canada Great Lakes Water Quality Agreement (Annex 2 of the 1987 Protocol). This particular AOC also includes Carp Creek and the Carp River. In 1981, fish were discovered in Deer Lake with mercury levels that exceeded 1.5 mg/kg. The Michigan Department of Public Health (MDCH) recommends a “ban on total consumption” for fish contaminated at these levels. Industrial additions of

mercury to this area occurred from the processing of gold ore at Ropes Gold Mine in the 1880s and during assaying tests on ore samples by a laboratory owned by Cleveland Cliffs Iron Company (CCIC).

A consent judgment for restoring the lake and for monitoring mercury levels in fish was entered into between the Michigan Department of Natural Resources (MDNR) and CCIC in 1984. From 1984 to 1986, Deer Lake was drawn down to 90 acres, killing most of the resident fish. In late 1986, the MDNR treated the lake with rotenone to kill the remaining fish. In 1987, the impoundment was refilled and the MDNR planted fingerlings of walleye and perch. Mercury levels in the fish initially increased, then decreased until 1995. The mercury in fish tissue has since leveled off, but is still above the trigger level for fish consumption advisories. There has been extensive testing in recent years to try to determine why the mercury concentration in the fish has not continued to decline (Hummer, 2001).

With Diane Feller’s permission, the AQD set up the M3L on her property approximately 20 meters from Deer Lake on July 20-22, 2005 (42°17.274’N, 83°9.518’W). The purpose of this sampling exercise was to obtain a “snapshot” of the gas phase atmospheric elemental mercury concentrations in the vicinity of Deer Lake. The ambient gas phase atmospheric Hg(0) measurements were within the range associated with mid-continent air masses (1.5-2.0 ng/m³) and very similar to concentrations measured over Lake Superior.



Picture 4. The M3L at Deer Lake.

The Lumex RA915+ was also used to measure dissolved gaseous Hg(0) in the lake water. Elemental mercury concentrations were approximately 60 pg/L, which is typical of uncontaminated sites in northern Michigan. Hence, no large atmospheric flux from Deer Lake was expected. The winds were from the N and NW during the sampling period.



Map 1. The M3L was set up at the southern end of Deer Lake to collect ambient air Hg(0) concentrations.

Hg (0) concentrations in the air were measured using a Lumex RA915+ at the site of the historic Ropes Gold Mine and the delta adjacent to it. Soil and Water samples were collected from the Ropes/Delta area and later analyzed for mercury at ORNL.

Ropes Gold Mine

Mr. Southworth was part of the group that took the Lumex RA915+ over to the Ropes gold mine area within the Deer Lake watershed. The site of the historic Ropes Gold Mine in Marquette County (46°29'N , 87°40'W) represents an area of known mercury use during the gold mining era of the late 1890s. Mercury metal had been used to extract gold from crushed ore at this site. Ambient air above the site of Ropes gold mine did not register any elevated Hg(0) with the Lumex RA915+.



Picture 5. Historic Picture of Ropes Gold Mine

Soil was extracted by shovel from several areas where it was suspected mercury from the gold mine operations of a century ago may have settled (see Picture 6). After initially



Picture 6. Soil extraction at Ropes Gold Mine

digging a very shallow hole, we waited approximately two minutes for any de-gassing of Hg(0) from the soil to equilibrate with the air volume within the hole. We then inserted the probe from the Lumex RA915+ and registered the concentration of gas phase elemental mercury in the hole. The elemental mercury concentrations measured in the air volume within the shallow holes, approximately 4-6 inches deep, were no different than the Hg(0) concentrations in the ambient air above the

holes. In several of the soil holes, however, the Lumex did register substantially elevated gas phase Hg(0) (up to greater than 1,000 ng/m³) when the hole was greater than 10 inches deep.

Soil samples were collected from the holes that registered elevated mercury concentrations. The soil samples were analyzed at the ORNL and the results suggest a profile with lesser amounts of mercury in the top 4 inches of soils and higher concentrations below 8 inches. Hg concentrations in soil samples taken from holes at a depth greater than 8 inches were at least 7, and as great as 10 times as large as the concentrations of soil samples taken from the surface in these same sampling locations (see Table 1).

Table 1. Hg in Soil Samples Taken from the Historic Ropes Gold Mine

Site	Sample Depth	Hg on Solids (µg/g dry weight of soil)
Ropes Gold Mine 1	surface	1.35
	10 cm	0.43
	22 cm	14.03
	45 cm	11.99
Ropes Gold Mine 2	surface	0.74
	12 cm	0.23
	22 cm	5.27
	30 cm	5.46
	44 cm	7.32

U.S. Geological Survey (USGS) data indicates that Marquette County soils contain mercury with an average concentration of 0.042 ± 0.022 µg/g. Of the 41 samples from Marquette County collected for analysis by the USGS, the maximum mercury concentration detected was 0.131 µg/g (USGS, 2005).

Additional analyses were conducted on soil and water from two holes dug in a delta zone on the west-end of the Causeway Pond (see Picture 7), where the drainage from the mining site enters Deer Lake. A clear Hg(0) vapor signal was evident in the shallow holes. The [Hg] in the delta soil was 3.42 ug Hg/g dry weight and total-Hg concentrations in filtered water (0.20 µm pore size) from the two pits were 33 and 46 ng/L. These samples indicate that the watershed is contaminated by legacy mercury and that mercury is being transported to the lake via shallow groundwater. Unsourced deeper groundwater flows entering Deer Lake via this drainage may contain similar or higher concentrations of dissolved Hg.



Picture 7. Collecting a water sample from a hole dug in the delta zone of Causeway Pond

Follow-up testing, especially groundwater testing, needs to be conducted before any definitive conclusions may be generated.

Taconite Facilities around Ishpeming

Car tour monitoring around the taconite piles near Ishpeming yielded uncertain data. Slightly higher elemental mercury concentrations downwind of the taconite tailing piles than upwind were seen, but the concentrations still seemed to be within normal “instrument drift” for the Lumex. Additional monitoring within and around the vicinity of the taconite plants would be needed to quantify releases from this source sector.

LANSING AREA MONITORING, JULY 19, 2005

Ingham Regional Medical Facility (IRMF)

Ingham Regional Medical Facility is a hospital located in Lansing, Ingham County, MI (42°17.274'N, 83°9.518'W). IRMF was chosen for monitoring because they operate a drum-top fluorescent bulb crusher, which may potentially release unacceptable levels of elemental mercury vapor and could possibly cause expensive contamination of its surroundings.

IRMF had been operating a Bulb Eater manufactured by Air Cycle Corporation for approximately two years at the time of our visit on July 19, 2005. This unit consisted of a drum-top mounted lamp crusher and a 55-gallon drum used to collect crushed material. Exhaust from the unit passed through a filter bag, HEPA filter, and activated carbon filter (laced with 15% yellow sulfur) before exiting to the ambient air. The sulfur combines with the mercury vapor to form an insoluble, non-volatile mercury sulfide (Davis, 2001).



Picture 8. A Bulb Eater

IRMF operated their Bulb Eater in a poorly ventilated room. When in use, the collection chamber on the crusher was under negative pressure with an air flow of 40 cfm. The feed chute for straight lamps had a screw-on cap to prevent fugitive emissions when the unit was off. The Bulb Eater is not equipped with a lamp counter system, mercury monitoring system, nor warning indicators for filter changes or full barrels. The operator needs to track the number and type of lamp crushed to determine when the carbon filters need replacing. IRMF employees changed the filter bag when the drum was half full and again when the drum was



Picture 9. IRMF employee feeds fluorescent bulbs into the crusher.

full. They changed the HEPA filter every 10 full drums. According to the manufacturer, the activated carbon mercury filter is rated for over 1,000,000 lamps (Air Cycle 2005). IRMF fed a mixture of both old and new lamps to its Bulb Eater and crushed about one box (36 bulbs) per day. For demonstration purposes, ~3 boxes (between 180-200 bulbs) were crushed while Lumex RA915+ monitoring was conducted.



Picture 10. Monitoring inside IRMF using the Lumex RA915+ and a laptop.

AQD staff and Mr. Southworth conducted monitoring at the facility on July 19, 2005. A Lumex RA915+ elemental mercury vapor analyzer was utilized to measure Hg(0) concentrations in the ambient air inside the room and on the roof immediately adjacent to the room where crushing was being conducted.

Significantly elevated concentrations of Hg(0) were detected inside the room when the crusher was operating, especially after a bulb was broken outside of the crusher. The mean Hg(0) concentration of the room before the Bulb Eater was operating was 156 ng/m^3 . Depending on where Lumex RA915+ monitoring was being conducted within the room, concentrations of Hg(0) ranged from $\sim 5 \text{ ng/m}^3$ to $\sim 901 \text{ ng/m}^3$. When the Bulb Eater was running and crushing bulbs, the Hg(0) concentration in the room steadily rose up to values around $13,000 \text{ ng/m}^3$. Outside on the roof directly adjacent to the crushing room, mercury concentrations were typical background levels with a Hg(0) mean concentration of $-1.24 \pm 12.12 \text{ ng/m}^3$. Monitoring in the crushing room after the

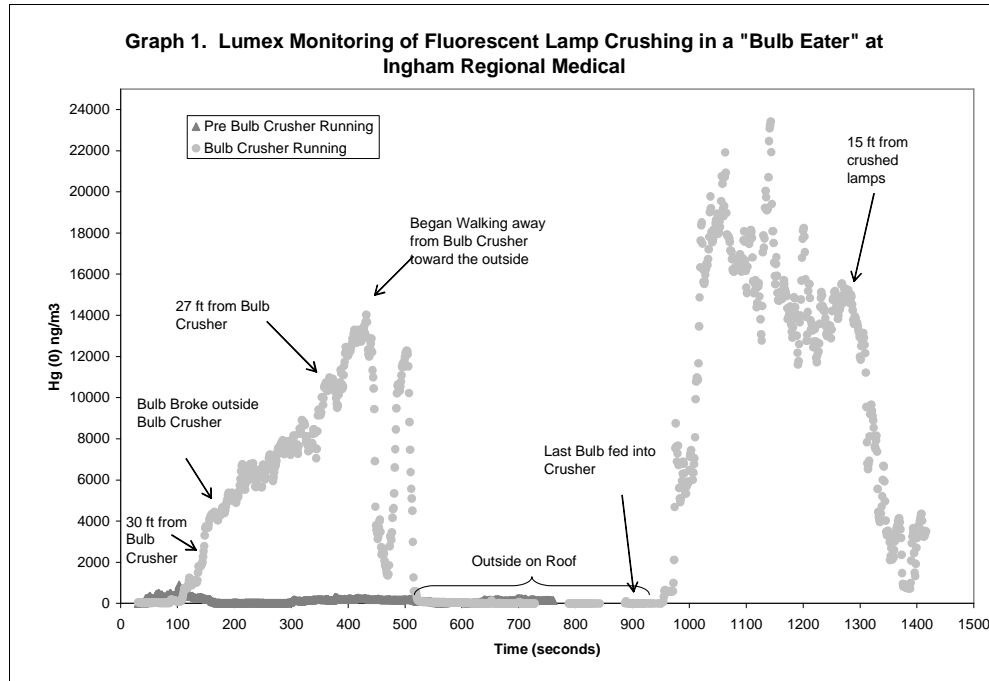


Picture 11. Using the Lumex to monitor on the roof of IRMF

last bulb was fed into the crusher and the crusher had stopped operating yielded concentrations of $\sim 15,000 \text{ ng/m}^3$. Concentrations of Hg(0) in the air directly next to the drum crusher may have been greater, but a distance of at least 15 ft from the drum crusher was maintained so the Lumex would not exceed its maximum detection limit and require an expensive cleaning. For comparison's sake, the National Institute for Occupational Safety and Health (NIOSH) set its recommended exposure limit (REL) for mercury vapor at 0.05 mg/m^3 ($50,000 \text{ ng}$). This recommended limit allows for up to a 10 hour workday for a 40 hour work week (NIOSH, 2005).

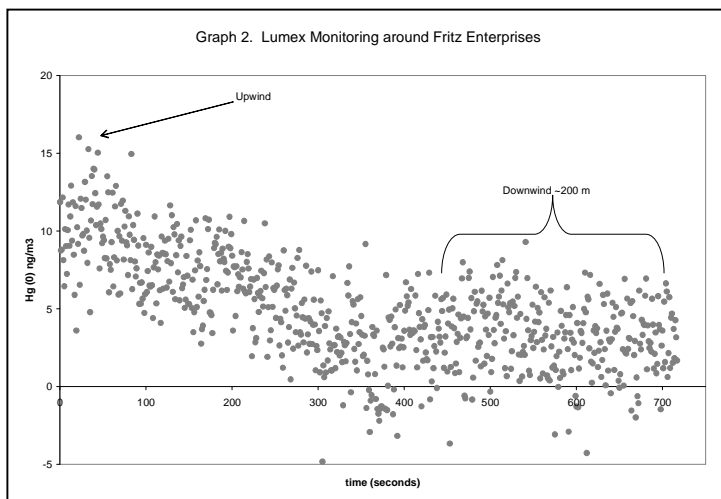
One confounder to these measurements is that one lamp was accidentally broken outside of the drum crusher. However, these measurements should be seen as measurements of normal activity. Occasionally, a lamp would be dropped and broken during normal operation of the crusher according to the operator. It was determined after discussions with IRMF staff that the facility was using a regular vacuum to clean up the broken glass

from broken fluorescent lamps when breakage occurred. They were cautioned against cleaning up mercury with a regular vacuum cleaner in the future and told that the current vacuum was likely contaminated with mercury and should be properly disposed. IRMF indicated that they planned to cease operation of the crusher after the monitoring visit.



DETROIT AREA MONITORING JULY 18, 2005

Fritz Enterprises



partially open window.

Fritz Enterprises is a scrapyard that recycles crushed automobiles and municipal scrap. It is located in Taylor, Wayne County, MI (42°10'N, 83°15'W). No clear downwind signal was evident when monitoring was conducted ~200 meters downwind of the facility on July 18, 2005. Monitoring was conducted from a vehicle with the Lumex RA915+ probe suspended in the ambient air out of a

AQD staff and Mr. Southworth visited this site on July 10, 2003 and conducted Lumex RA915+ monitoring. A clear steam plume from the shredder was evident on this visit. The Hg(0) signal, if any, was quite weak. A mercury flux from Fritz Enterprises was crudely estimated to be 1.6 grams per day or 1.3 pounds per year based on the July 2003 monitoring event (Southworth, 2003).

Strong Steel

Strong Steel is an automobile and steel shredder in Detroit, Wayne County, Michigan (42°23'N, 83°02'W) with water spray to control dust. Monitoring was conducted on July 18, 2005, a sunny day with a wind speed of ~2 m/sec. A clear downwind Hg(0) signal within a distinct plume was measured using the Lumex RA915+. Monitoring was conducted from a vehicle with the Lumex RA 915+ probe suspended in the ambient air out of a partially open window.



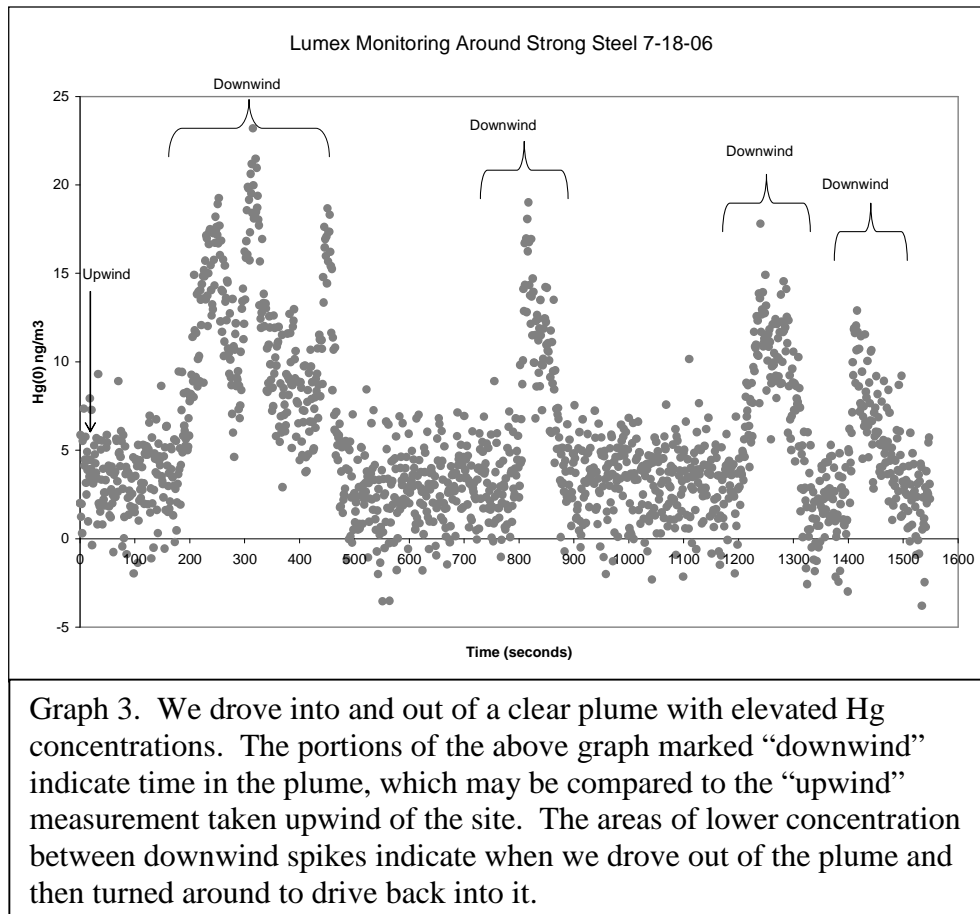
Picture 12. Strong Steel (viewed from above)

These measurements were used to calculate a rough flux estimate from the site. The plume width was estimated to be approximately 500 meters and the plume height 20 meters, yielding an area cross section of ~10,000m². The boundaries of the plume were evident by viewing the Lumex RA915+ measurements on the laptop. We could drive through the plume and the recorded measurements documented when we exited the plume. Within the plume, Hg(0) concentrations ranged from ~3 ng/m³ to 23 ng/m³. Average mercury concentrations in the plume exceeded measured upwind background levels by approximately 15 ng/m³. A crude Hg(0) flux of about 1 lb per year was generated using this measured data and the maximum hours that the shredder is allowed to operate,

according to its permit. The shredder can operate a maximum of 5008 hours per year.



Picture 13. A clear plume was detected while monitoring on Strong Street between Ackley and Sherwood. Hg(0) concentrations in the plume rose to ~20 ng/m³ and abruptly dropped to background concentrations upon exiting the plume. The estimated plume is shaded.



Kerr Corporation



Picture 14. Hg in pillow packs at Kerr

Kerr Corporation is a manufacturer of dental products located in Romulus, Wayne County, Michigan. Kerr is the only dental amalgam manufacturer in Michigan. They manufacture dental amalgam capsules that are composed of metal alloy and mercury. All of Kerr’s Hg(0) is stored in a cool room (temperature <70°F) adjacent to the room where the capsules are filled. In the last three or four years, Kerr has switched from

using bulk elemental mercury in the manufacturing process to using Hg(0) that comes from Germany in pillow packs (Hg(0) encapsulated in soft plastic

capsules—see Picture 14). These pillow packs are fed through a machine that puts the mercury in the capsules using a blast of air. Then the alloy composed of copper, tin, and silver is added. Capsules come in 400, 600, or 800 mg sizes with the 400 mg size being the most common. The capsule size denotes the amount of alloy in the capsule. The amount of mercury in each capsule varies slightly, but is usually about equal to the amount of alloy. These capsules are sent to dental offices where they will be mixed so that the Hg and alloy combine to form amalgam for fillings.



Picture 15. An overhead view of Kerr. Indoor Hg concentrations are in white and outdoor Hg concentrations are in black text.

tions at what is considered to be background (1-2 ng/m³).

Monitoring inside the building was also conducted using the Lumex RA915+. Most of the building had Hg(0) concentrations between 400 and 600 ng/m³. The rooms where the mercury pillow packs were stored and the room where the capsules were filled with Hg(0) demonstrated greater concentrations. The cool storage room had an average Hg(0) concentration of ~5,000 ng/m³ during this monitoring event. It appears that some Hg(0) can diffuse through the plastic that encapsulates the mercury in the pillow packs as the concentration directly next to a jar of pillow packs (~6000 ng/m³) was greater than the concentration in the rest of the room. Because monitoring in the room where the capsules were filled coincided with lunch time, the process was not running when monitoring in this room took place. Concentrations in this room were approximately 1150 ng/m³.



Picture 16. Lumex RA 915+ monitoring in the cool storage room.



Picture 17. Jars of finished amalgam capsules at Kerr in the room where the capsules are filled.

Using monitoring results and information about the building's ventilation system and volume, a flux estimate for this facility was generated. The building volume is 44,309 m³. The ventilation rate is on average nine air exchanges per hour. The building had an average mercury concentration of 500 ng/m³ (as measured by the Lumex). Using this information, a flux estimate of less than 4 lbs of Hg(0) emitted per year was calculated.

Padnos Shredder

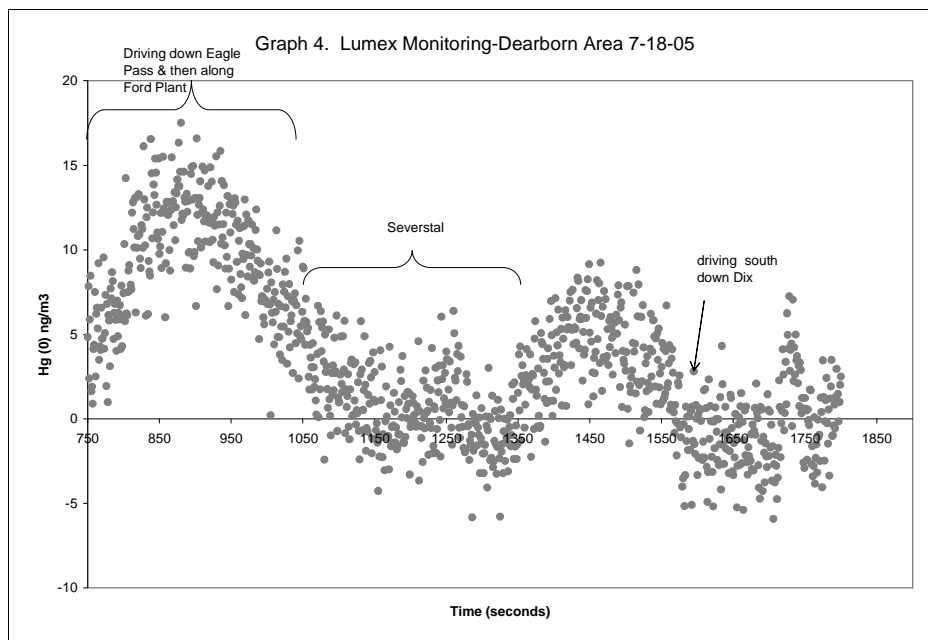
Padnos is a scrap metal shredder located in Lansing, Ingham Co, Michigan (42°45'N, 84°35'W). Lumex monitoring was conducted around the Padnos Shredder facility using a vehicle and a Lumex RA915+. Monitoring of the ambient air was conducted upwind and downwind of the facility while the shredder was running, as indicated by a plume of steam. The wind was gusty and variable. Elevated concentrations of Hg(0) were not apparent during the upwind or downwind monitoring.



Picture 18. Padnos Shredder

Dearborn Area Monitoring

There were several potential sources of Hg(0) in the Dearborn area including a Ford Plant, Severstal (a steel manufacturing facility), and other industries. There were somewhat elevated concentrations of Hg(0) near Severstal/the Ford plant. Another pass directly adjacent to Severstal yielded concentrations that appeared slightly elevated. When the Lumex RA 915+ was driven upwind of the area these facilities are located in, concentrations dropped back down to normal background levels for the Detroit area.

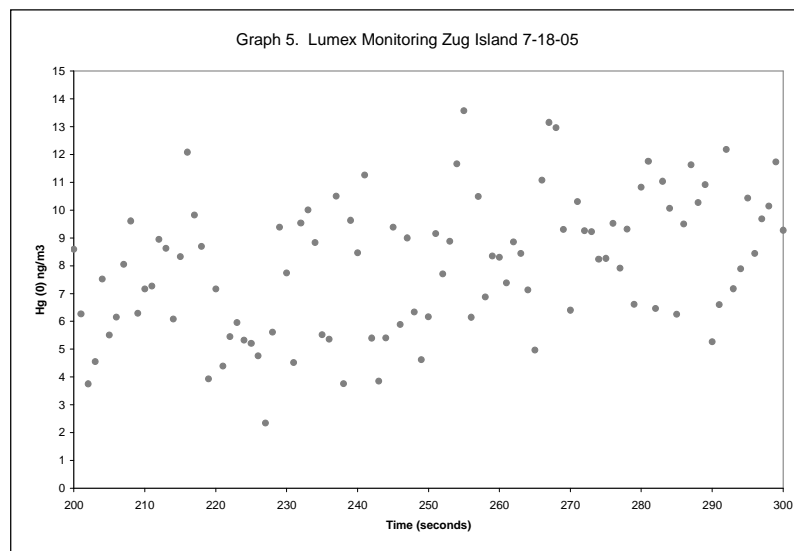


Zug Island Area Monitoring

The most likely Hg(0) source on Zug Island is the US Steel-Great Lakes Works. Ambient monitoring conducted adjacent to the facility with the Lumex RA915+ yielded slightly elevated Hg(0) concentrations. A Tekran 2537A was placed at South Delray, a neighborhood in Detroit across from Zug Island, and collected average ambient Hg(0) measurements every five minutes from October 2004 until December 2005. Analysis of these data is expected to be completed summer 2006.



Picture 19. US Steel-Great Lakes Works



Conclusions and Recommendations

The partnership between the MDEQ AQD and the ORNL has continued to be a great success, as is evident by the work highlighted in this report. The atmospheric mercury monitoring work that was conducted during the summer of 2005 further identified previously unstudied mercury sources in Michigan. Legacy mercury in Michigan continues to be a source of contamination to such water bodies as Deer Lake.

Fugitive elemental mercury sources were further quantified in Michigan, including a fluorescent drum crusher, a scrap metal recycler, automobile and steel shredders and a dental amalgam manufacturer. Based on limited measurements, approximately one pound per year was estimated for the scrap metal recycler and automobile and steel shredder, and less than four pounds per year was estimated for the dental amalgam manufacturer. These estimates were extrapolated from measurements that were very limited in time and resources. For example, there was only one monitor used at most of the sites. Longer-term monitoring would yield an emissions estimate that is more

representative of actual annual emissions. However, these short-term measurements are useful to generate an approximation of emissions and to delineate and prioritize what sources need longer-term monitoring. The fluorescent bulb crusher appears to be more of a concern for indoor air exposure than for release to the atmosphere, at this location. The largest fugitive source of elemental mercury studied appears to be the dental amalgam manufacturer emitting approximately four pounds of mercury each year. While the scrap metal recycler and automobile and steel shredder appear to be relatively small sources, cumulative Hg (0) releases from many small sources like those studied can lead to appreciable mercury releases in the state. The statewide emissions from shredding automobiles have been estimated at 117 pounds for the 2002 Michigan mercury emissions inventory (MDEQ, 2006). This estimate was generated using a flow model that estimates emissions throughout the lifecycle of a mercury-containing product. Because of the many assumptions inherent in this method, there exists a great degree of uncertainty to this estimate (MPCA, 2001; Cain, 2005). To fully characterize the overall impact of the steel recyclers and shredders in the state, a longer term monitoring study would need to be conducted. Current measures being taken to remove mercury-containing switches in appliances and automobiles should lead to further reductions in fugitive emissions in the near future from this source category.

Recommendations:

- 1) Continue to support the AQD and ORNL scientists for further work in assessing mercury released and deposited in Michigan's environment.
- 2) Fluorescent lamp recycling should continue; however, the lamps should be recycled at a permitted facility that operates with control equipment designed to effectively capture fugitive elemental mercury emissions.
- 3) Conduct additional monitoring at other fugitive mercury sources in Michigan including a mercury-switch manufacturer, waste transfer stations, taconite facilities, additional metal shredders and others.
- 4) Further work should be done to quantify overall legacy mercury loadings and their impact on Michigan's environment.
- 5) Atmospheric monitoring of all species of mercury (reactive gaseous mercury, particulate mercury, and elemental mercury) should be conducted to better quantify the total release of mercury from sources. Limited speciated monitoring being conducted by the University of Michigan at two locations in Michigan should continue, and the monitoring sites should be expanded.

Prepared by: Leah Granke, Toxics Unit, Air Quality Division
Joy Taylor Morgan, Toxics Unit, Air Quality Division
George Southworth, Oak Ridge National Laboratory.

A special thanks to Amy Robinson with the Air Monitoring Unit of the MDEQ's Air Quality Division for her technical assistance and support and to Doug Knauer and George Pelkola, MDEQ's Water Bureau and Diane Feller, Michigan Upper Peninsula resident for their assistance during the Deer Lake monitoring.

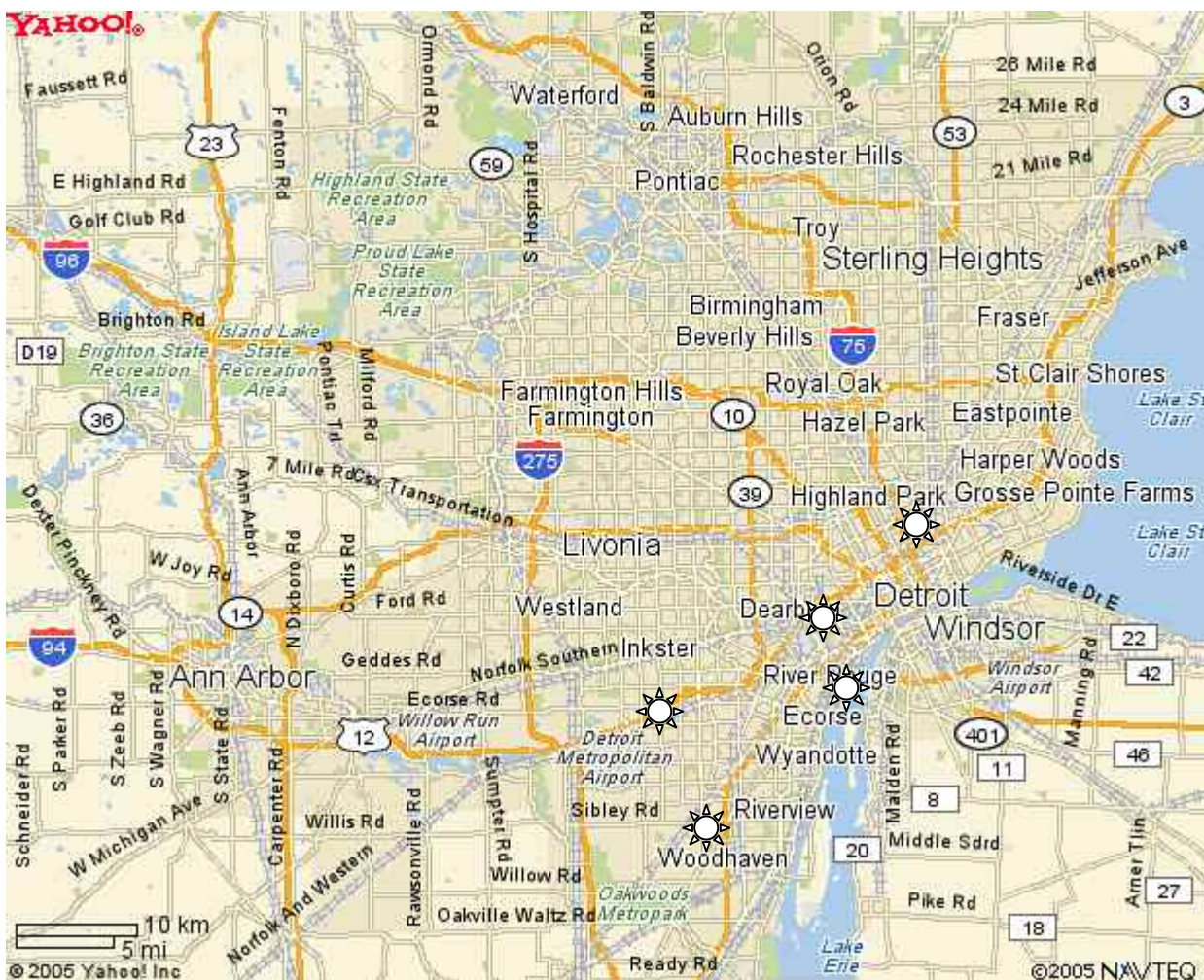
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Appendix A. Maps of Monitoring Locations



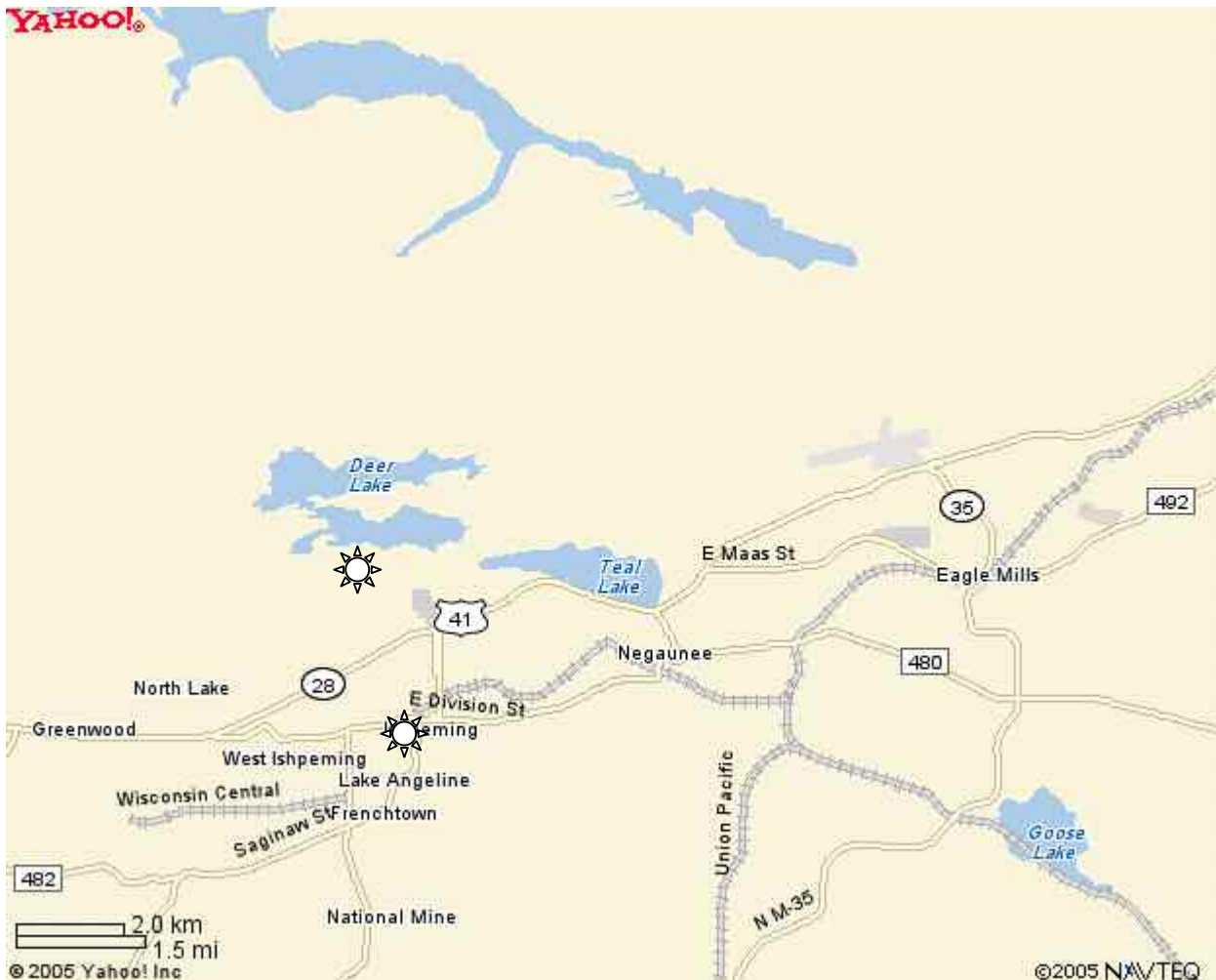
Map 2. During July 2005, mercury monitoring was conducted using either a Lumex RA 915+ or two Tekran 2537A mercury analyzers at various locations near Detroit, in Lansing, and in the vicinity of Ishpeming in the Upper Peninsula of Michigan. See Maps 3, 4, and 5 for more detail on specific monitoring locations.



Map 3. Car tour monitoring in the Detroit area was conducted using the Lumex RA 915+. Sampling took place at/or in the vicinity of Kerr Corporation in Romulus, Fritz Enterprises in Taylor, Strong Steel in Detroit, Severstal in Dearborn, and Zug Island in River Rouge. See the [monitoring summaries](#) above for the results of this monitoring.



Map 4. The Lumex RA915+ was used to monitor elemental mercury emissions from a “Bulb Eater,” a type of drum-top fluorescent lamp crusher, at the Ingham Regional Medical Facility, 401 W. Greenlawn Avenue in Lansing, MI. See [pages 5-7](#) of this report for monitoring results.



Map 5. The Mercury Monitoring Trailer featuring two Tekran 2537A mercury analyzers and meteorological equipment was set up ~20 meters from the shore of Deer Lake. Monitoring using the Lumex RA915+ was conducted in the area surrounding Deer Lake in an effort to locate the source of continued mercury input to the lake. Water and Soil samples were also collected in the area surrounding Deer Lake.

Car tour monitoring using the Lumex RA 915+ was conducted in the Ishpeming area to investigate Taconite tailing piles as a possible ambient air mercury source.

Appendix B. Continental Aluminum Monitoring Report



JENNIFER M. GRANHOLM
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING



STEVEN E. CHESTER
DIRECTOR

November 15, 2005

Ms. Christina Bush, Toxicologist
Michigan Department of Community Health
Division of Environmental and Occupational Epidemiology
Toxics and Response Section
Capitol View Building, 4th Floor
201 Townsend Street.
Lansing, Michigan 48913

Dear Ms. Bush:

This letter is in response to Michigan Department of Environmental Quality (DEQ), Air Quality Division's (AQD's) commitment to conduct follow up on monitoring around the Continental Aluminum facility located in Lyon Township, Oakland County. Staff from the Air Monitoring and Toxics Units of the AQD conducted ambient mercury monitoring around the periphery of the facility on June 14, 2005; September 28, 2005; and October 5, 2005. Monitoring was conducted utilizing a Lumex RA 915+ handheld, portable, elemental mercury monitor.

Mercury levels around the facility were only slightly elevated above concentrations considered to be background. Therefore, this source is not estimated to be a significant source of elemental mercury to the atmosphere. Because the concentrations were not elevated to levels indicative of significant mercury sources, the mobile mercury monitoring trailer was not deployed for further follow-up studies. The attached report describes the monitoring activity conducted within the vicinity of Continental Aluminum.

If you have any further questions regarding the collected data, please contact Ms. Joy Taylor Morgan, AQD, Toxics Unit, at 517-335-6974.

Sincerely,

G. Vinson Hellwig, Chief
Air Quality Division

Attachment

cc: Mr. Craig Fitzner, DEQ
Ms. Catherine Simon, DEQ
Ms. Teresa Seidel, DEQ
Ms. Joy Taylor Morgan, DEQ
Ms. Amy Robinson, DEQ
Ms. Leah Granke, DEQ

Mercury Monitoring around Continental Aluminum June 14, September 28, and October 5, 2005

Background

Continental Aluminum is a secondary aluminum smelter located in Lyon Township, Oakland County, Michigan (42.50° N, 83.62° W). Secondary aluminum smelters recycle aluminum from aluminum-containing scrap, while primary aluminum producers convert bauxite ore into aluminum. Secondary aluminum production involves the pretreatment of aluminum-containing scrap and the smelting/refining of this scrap.

In response to a petition for a public health assessment by local citizens, the MDCH conducted a three-month exposure investigation (EI) from March through May 2004. MDCH investigated the presence of acidic aerosols and concentrations of airborne metal particulates, elemental mercury and volatile organic compounds (VOCs). A limited set of elemental mercury data collected during the EI time period demonstrated concentrations exceeding background levels. Background concentrations in clean areas, that is those geographic areas not impacted by urban sources, are known to be approximately 1.5 ng/m³ in Michigan and elsewhere (Keeler 2003, Malcolm et al. 2003 and Bullock 2004). Although the highest concentrations appeared to be when the wind was not blowing from the vicinity of the Continental Aluminum facility, the MDEQ agreed to conduct follow-up monitoring to determine if elevated elemental mercury concentrations were originating from the facility.

Follow-Up Monitoring Summary

Amy Robinson, Air Monitoring Unit; Patrick Bigelow, Air Monitoring Student Assistant; and Joy Taylor Morgan and Leah Granke, both with AQD's Toxics Unit, monitored the vicinity surrounding the facility on June 14. On September 28 and October 5, monitoring was conducted by Ms. Robinson, Ms. Taylor Morgan, and Ms. Granke.

The smelter was operating on all occasions when MDEQ staff visited the site. Operation of the smelter was evident by a burning refuse/sulfurous odor on June 14 and especially on September 28 (when located within 50 yards downwind of facility) and by noise. Monitoring was conducted without notifying the company ahead of time. On June 14, the weather was cloudy and warm (84° F and 53% humidity), with a 14 mph wind from the south gusting to 23 mph as reported by the Oakland County International Airport, which is located approximately 31 miles northwest of the facility, in Pontiac. On September 28, 2005, it was sunny and warm (77° F) with a variable south/southwest breeze ranging from zero to 6 mph as measured by a LaCrosse Technology anemometer. The weather on October 5, 2005 was also warm (79 ° F) and

sunny with a variable light southwest breeze (~0-2 mph), as measured by the anemometer.

Monitoring was conducted utilizing a hand held portable Lumex RA 915+ monitor that measures and provides continuous real-time data for elemental mercury [Hg(0)]. Airborne Hg(0) measurements were collected both during car tours and by walking around the periphery of the facility. During car tour monitoring, the monitoring probe was suspended in the ambient air through a partially open window. For the on-foot monitoring, the probe was held in the ambient air at approximately chest height. A hand held geocoordinate positions system (GPS) device (Garmin eTrex Vista) was also utilized to record locations where sampling occurred. Both car tour monitoring and monitoring on foot involve connecting the Lumex RA 915+ monitor to a laptop that automatically downloads the data collected from the continuous ambient monitor. On June 14, during monitoring while walking on the bike path behind Continental Aluminum, the laptop was not used because of laptop battery failure. Instead, ten second averages were calculated by the Lumex and recorded by hand.

The monitoring locations were chosen to provide a representative sample of upwind and downwind ambient mercury levels in the vicinity of Continental Aluminum (see Map of Monitoring Activities). The intersection of Travis Rd and Fletcher Ln provided an upwind background reading. This was the baseline, which was compared with downwind readings to determine if elevated mercury levels were present. The bike path monitoring location provided close access to the fence line of the Continental Aluminum property. The MDCH monitoring had been conducted at Dolsen Elementary School. Consequently, AQD also monitored at Dolsen Elementary school. Monitoring along Grand River Avenue was conducted to screen for potential mercury sources other than Continental Aluminum.

The upwind measurement (corner of Travis Road and Fletcher Lane) found Hg(0) concentrations were at the minimum detection limit (MDL) of the Lumex at approximately 2 ng/m³ (see Graph 1). It is normal for the Lumex to experience "instrument drift" where the values recorded fluctuate above and below the actual ambient air measurement for a location. This drift can result in values less than the MDL being recorded by the Lumex. Values less than the MDL should be interpreted as equivalent to the MDL of 2 ng/m³.

Airborne Hg(0) measurements around the vicinity of the facility indicated that most measured downwind concentrations were very close to background concentrations. During the September 28, 2005 sampling event, levels were elevated above background when approximately 50 yards directly downwind of the facility on the bike path (see Graph 2). During this sampling event, the battery failed on the Lumex. The data collected prior to the Lumex battery failing should be considered valid, however, since all of the Lumex operating

parameters were within their normal range (personal communication with OhioLumex personnel). A precise plume estimate based on this data is not possible because the battery failed before the instrument exited the plume. However, an approximate range of Hg emitted from Continental Aluminum can be calculated using the stack height, modeled estimates for plume width, wind speed, the average mercury concentration in the plume, and facility operating data. Based on these data, we can expect that Continental Aluminum emits between <1 and 2.34 pounds of elemental mercury per year. It should be noted that this estimate was generated from the limited, periodic, short-term monitoring that MDEQ conducted and should be considered fairly rough. The data from these sampling events suggests that Continental Aluminum is a relatively minor source of mercury.

During the car tours, the concentrations were primarily at the minimum detection limit of the instrument. Concentrations around Dolsen Elementary School (42.51°N, 83.61°W) approximately one mile northeast of Continental Aluminum, were at detection (see Graph 3). Therefore, during these specific sampling events, levels did not appear to be elevated at Dolsen Elementary School.

The ambient air concentration of Hg(0) did increase during the June 14 car tour when we moved away from Continental Aluminum and drove to Trident Industrial Blvd/Lyon Oaks Drive area, approximately 2.5 miles east of the facility (see Graph 4). The highest concentrations detected were approximately 14 ng/m³ (see Graph 5), which indicated the possibility of a source of Hg(0) nearby. While it is normal for the Lumex to experience "instrument drift," this sampling event showed an increase above normal drift in the vicinity surrounding Trident Industrial Boulevard and Lyon Oaks Drive. The source, however, could not be confirmed as there were numerous buildings within the vicinity of where somewhat elevated concentrations were detected, and the September 28 and October 5 sampling events did not yield the elevated levels seen during the June 14 event.

Conclusion

During monitoring on June 14, September 28, and October 5, 2005, Continental Aluminum did not appear to be a source of a significant amount of Hg(0) to the atmosphere. No further monitoring is planned at this time.

Appendix B. Mercury Monitoring Around Continental Aluminum
June 14, September 28, and October 5, 2005

References

Keeler, G. J. Mercury monitoring in Michigan and the Great Lakes Basin – methods and source characterization. Presented at: Great Lakes Regional Workshop – Measuring Atmospheric Mercury: Goals, Methods, and Results. 2003 Mar 26, East Lansing, Michigan.

Malcolm, E. G., G. J. Keeler, and M. S. Landis. The effects of the coastal environment on the atmospheric mercury cycle. J Geophysical Res 2003;108(D12):4357.

Bullock, R. O., Global emissions and transport: what is known and unknown. Presented at: USEPA/USGS Mercury Roundtable; 2004 Sep 15, quarterly conference call.

Compiled by:

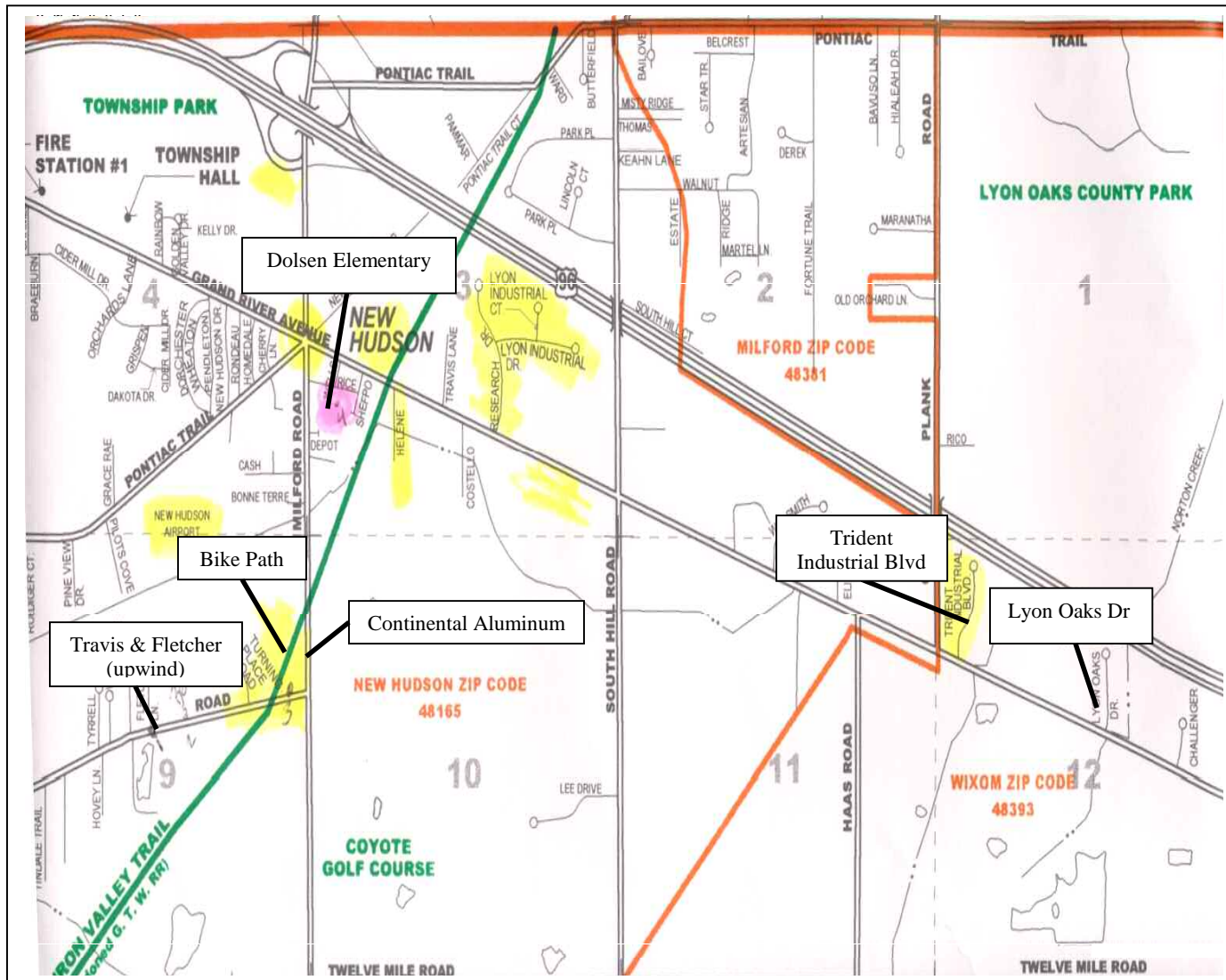
Joy Taylor Morgan, MDEQ, Air Quality Division, Toxics Unit

Leah Granke, MDEQ, Air Quality Division, Toxics Unit

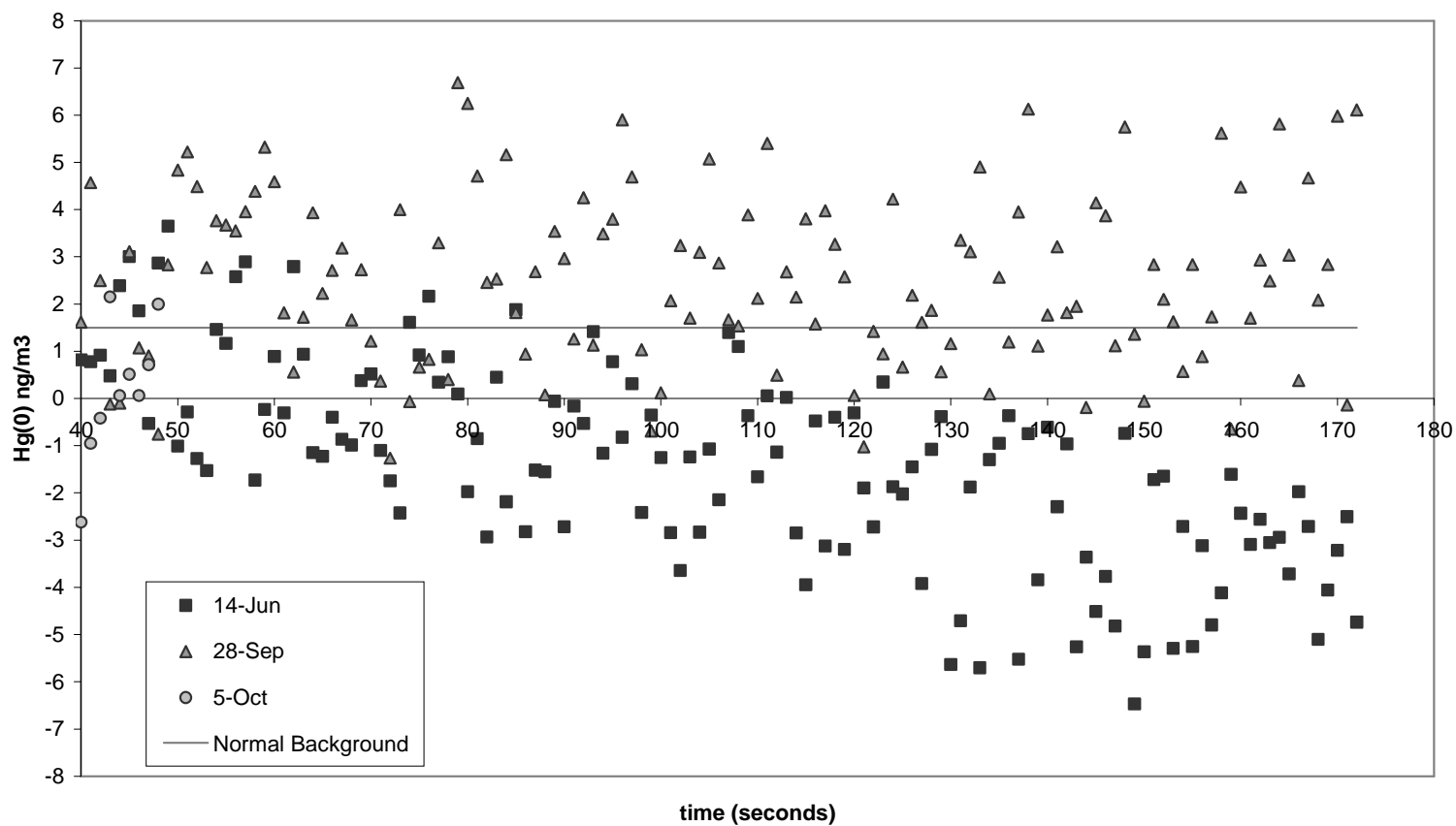
Amy Robinson, MDEQ, Air Quality Division, Air Monitoring Unit

November 7, 2005

Map of Monitoring Activities:

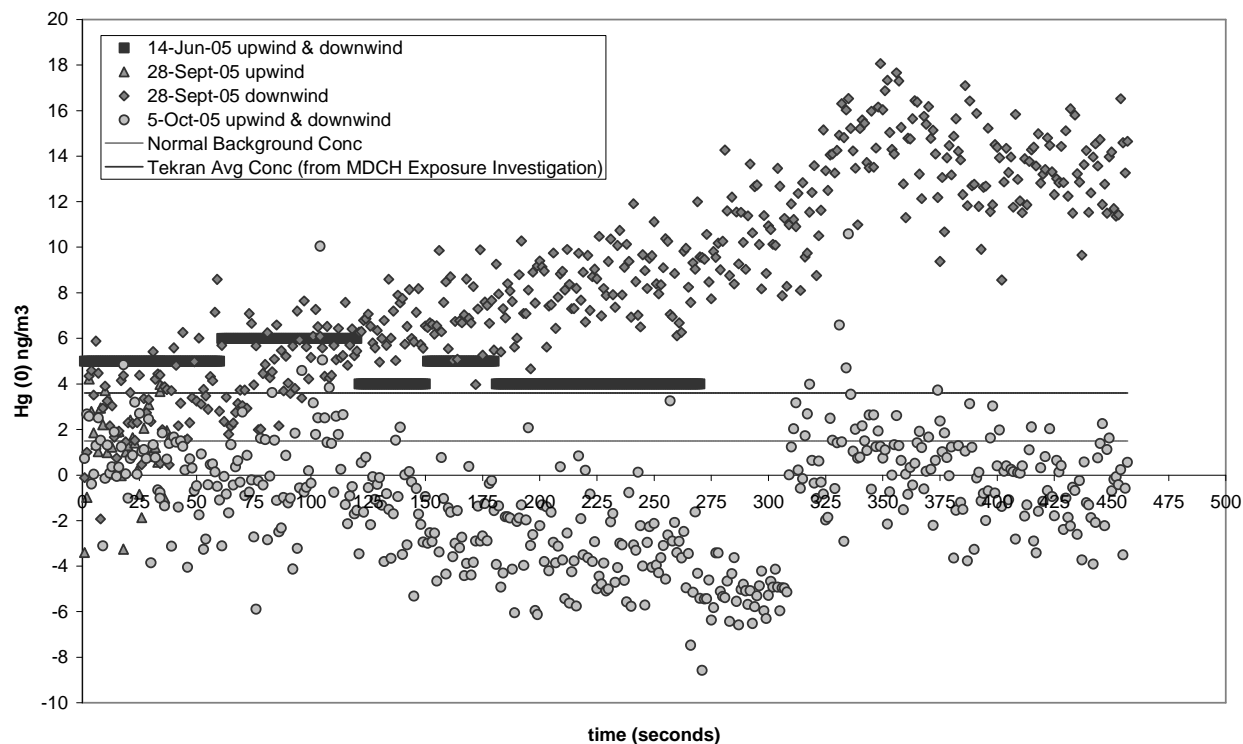


Graph 1. Lumex Monitoring at Travis & Fletcher (Upwind Background)



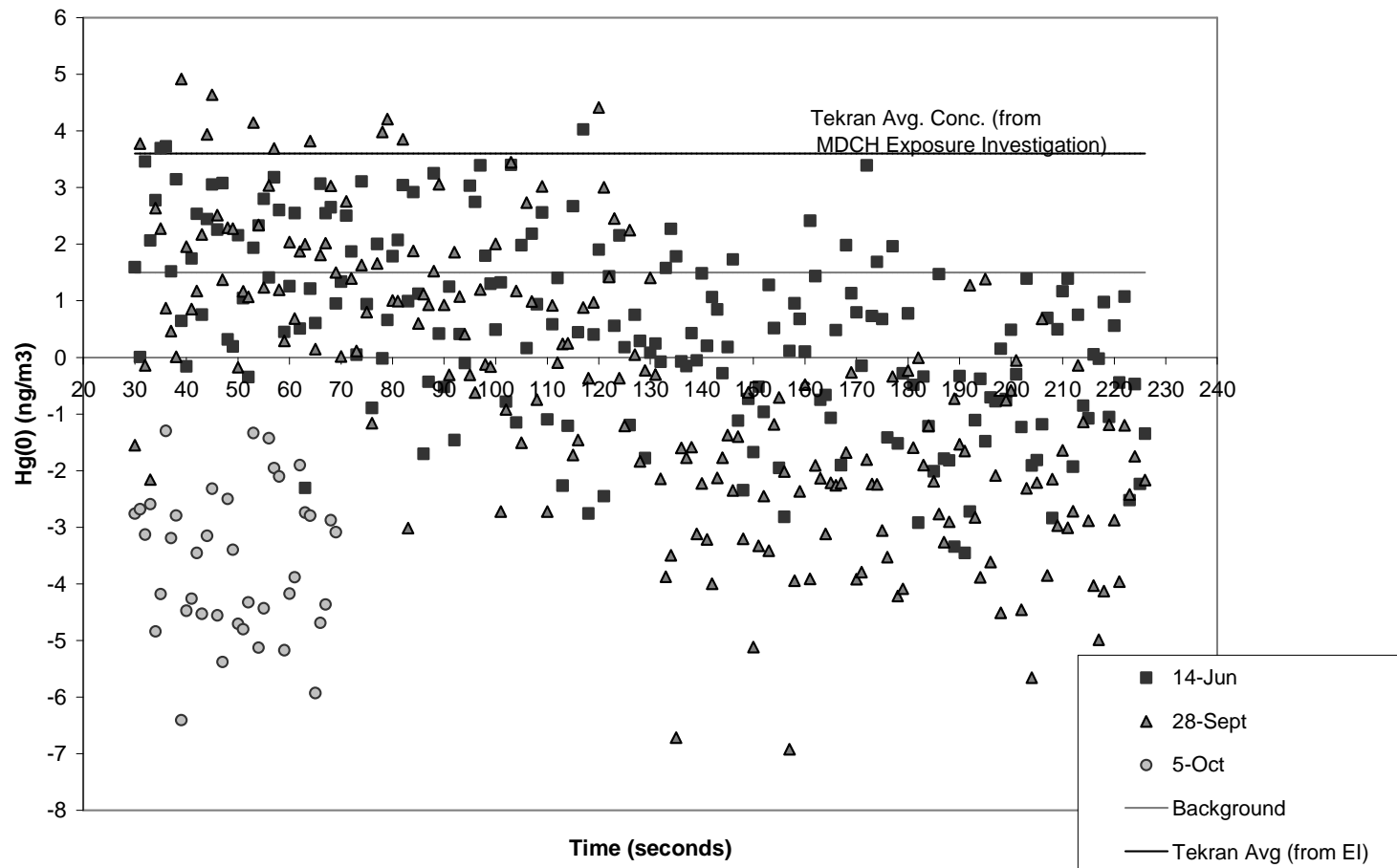
Graph 1. The upwind background reading was taken west and slightly south of the facility at the intersection of Travis Road and Fletcher Lane (see Map of Monitoring Activities). This reading is at the detection limit of the Lumex at approximately 2 ng/m³.

Graph 2. Lumex Monitoring On the Bike Path



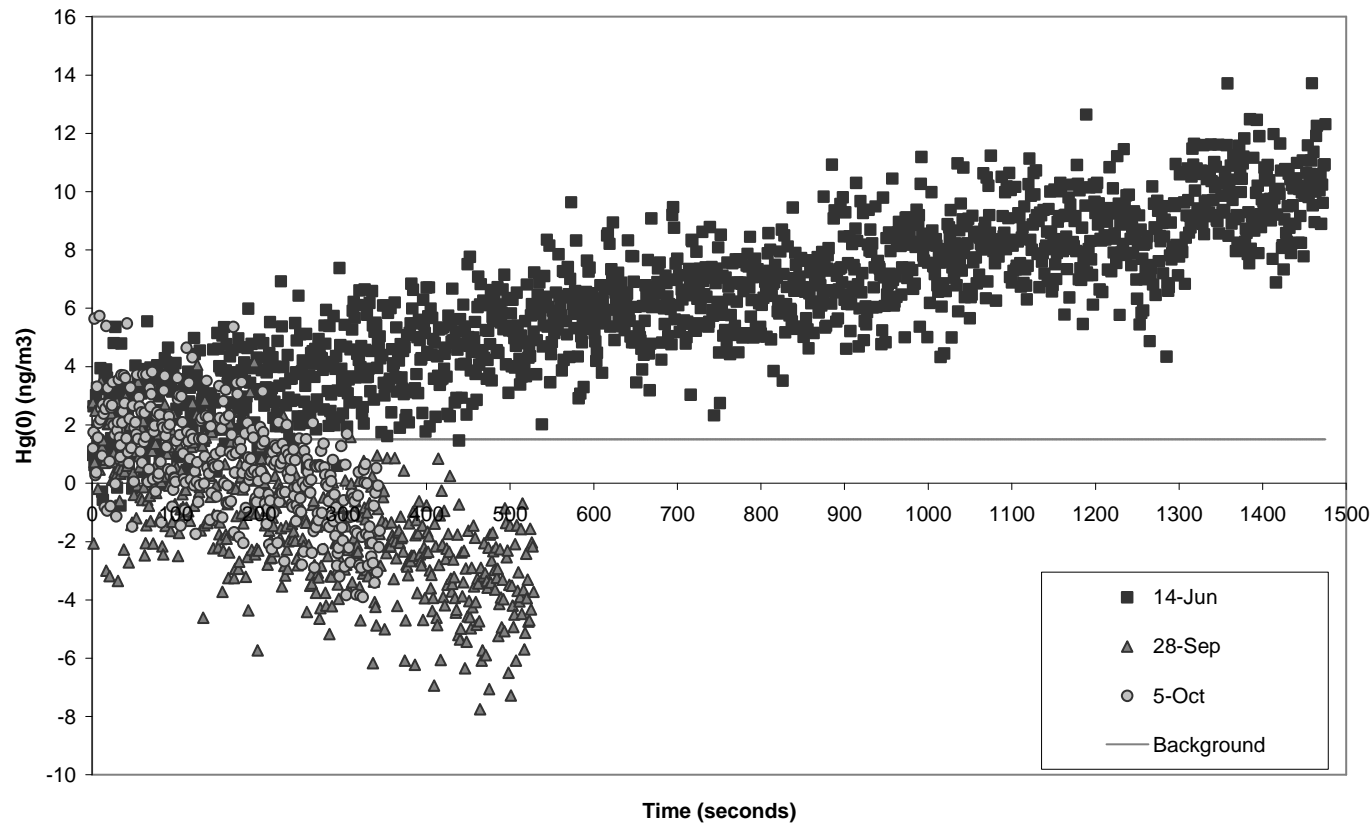
Graph 2. The bike path is southwest and upwind of the facility at its intersection with Travis Rd (see Map of Monitoring Activities). Near the bike path's intersection with Milford Rd, it is north and slightly west of the facility and is a good location for downwind monitoring. During the June 14 monitoring, the laptop's battery failed. As a result, the June 14 values are 10-second averages that were recorded by hand. Hence, the June 14 values on this graph are all whole numbers, unlike the other sampling events. Notice that somewhat elevated values were detected downwind of the facility during the September 28 monitoring event. During this monitoring event, the Lumex battery failed, prohibiting further downwind monitoring of these elevated levels.

Graph 3. Lumex Monitoring at Dolsen Elementary



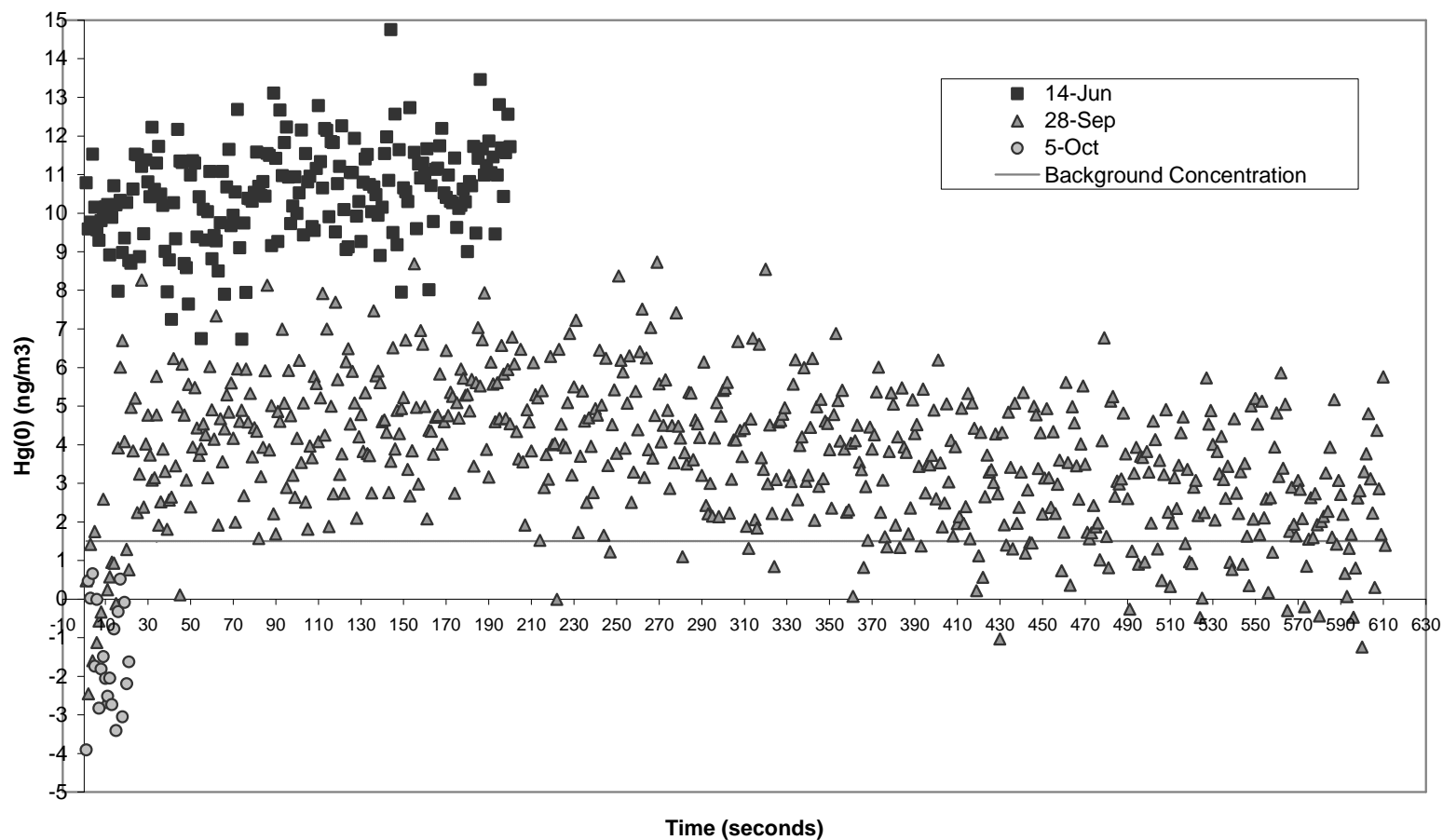
Graph 3. Dolsen Elementary is located approximately 1 mile northeast of Continental Aluminum (see Map of Monitoring Activities). The readings at this site were at the detection limit of the Lumex at $\sim 2 \text{ ng/m}^3$.

Graph 4. Lumex Monitoring moving East on Grand River



Graph 4. This graph shows the values detected during car tour monitoring driving East on Grand River from the vicinity of Dolsen Elementary to Trident Industrial Blvd (see Map of Monitoring Activities). On June 14, a slightly elevated signal was evident in the vicinity of Trident Industrial Blvd, but this signal was not present during the September 28 and October 5 sampling events.

Graph 5. Lumex Monitoring on Trident Industrial Blvd



Graph 5. The area around Trident Industrial Blvd and Lyon Oaks Dr. (see Map of Monitoring Activities) showed a slightly elevated signal during the June 14, 2005 monitoring event. An elevated signal was not present during the September 28 and October 5 monitoring.